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Claims

[c1] A process for providing an oxide gap fill on a substrate, comprising:
providing a substrate with gaps to be filled;
contacting the substrate with a first oxide precursor under high density plasma conditions at a first pressure less than about 10 millitorr, wherein said gaps are partially filled with a first oxide material; and
further contacting the substrate with the second oxide precursor and an inert gas under high density plasma conditions at a second pressure greater than 10 millitorr, wherein said gaps are further filled with a second oxide material.

[c2] The process of Claim 1, wherein the second pressure is greater than about 50 millitorrs.

[c3] The process of Claim 1, wherein the second pressure is at about 100 millitorrs to 500 millitorrs.

[c4] The process of Claim 1, wherein the second pressure is greater than about 500 millitorrs.

[c5] The process of Claim 1, wherein the steps are repeated to completely fill the gap.

[c6] The process of Claim 1, wherein the inert gas comprises argon, helium, hydrogen, or combinations comprising at least one of the foregoing gases.

[c7] The process of Claim 1, wherein the gas flow and power are constant during high-density plasma conditions of the first and second pressures.

[c8] The process of Claim 1, wherein the first and second oxide materials are different.

[c9] The process of Claim 1, wherein the first and second oxide materials comprise silicon dioxide,silicon nitride, silicon oxynitride, silicon carbide, phosphorous silicon-doped glass, boron phosphorous silicon-doped glass, tetraethoxysilane based silicate glass, and fluorinated silicate glass.

[c10] A method of depositing a conformal dielectric layer on a substrate disposed in a process chamber, comprising: providing a substrate on an electrode in the process chamber, wherein the substrate has at least one gap; flowing an oxide precursor into the process chamber under high density plasma conditions at a pressure less than 10 millitorr to partially fill the at least one gap; and increasing the pressure in the chamber to greater than 10 millitorr and flowing an inert gas into the chamber to

fill the at least one gap.

[c11] The method of Claim 10, wherein the inert gas comprises argon, helium, hydrogen, or combinations comprising at least one of the foregoing gases.

[c12] The method of Claim 10, wherein the pressure in the chamber is increased to greater than 50 millitorr.

[c13] The method of Claim 10, wherein the pressure in the chamber is increased to greater than 100 millitorr.

[c14] The method of Claim 10, wherein the pressure in the chamber is increased to greater than 1,000 millitorr.

[c15] The method of Claim 10, wherein flowing the oxide precursor comprises silane and oxygen gas.

[c16] The method of Claim 10, wherein flowing the oxide precursor comprises flowing silane at a flow rate of about 20 to about 120 sccm, flowing oxygen at a flow rate of about 30 to about 250 sccm, and flowing argon at a flow rate of about 0 to about 100 sccm.

[c17] The method of Claim 10, wherein the at least one gap has an aspect ratio greater than 2:1.

[c18] The method of Claim 10, wherein flowing the oxide precursor into the process chamber is at a constant flow

rate and a constant power.